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Following is a translation of three articles from the Russian-language publication Bol'shaya meditsinskaya entsiklopediya (Great Medical Encyclopedia), Vol 26, State Scientific Publishing House "Soviet Encyclopedia," Moscow, 1962. Complete bibliographic information accompanies each article.

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NATURAL FOCUS

/Following is a translation of an article by Ye. Pavlovskiy in the Russian-language publication Bol'shaya meditsinskaya entsiklopediya (Great Medical Encyclopedia), Vol 26, State Scientific Publishing House "Soviet Encyclopedia," Moscow, 1962, pages 764-775./

Natural focus (of diseases) is a characteristic of certain diseases based on the fact that in nature they have foci of evolutionary origin, the existence of which is a result of the consecutive transfer of the pathogen of such a disease from one animal to another, usually through the medium of bloodsucking invertebrates (mites and ticks, insects); natural foci of diseases are related territorially to biotopes of the geographical landscape; when a human being enters such an area at a certain time of the year, the hungry carriers which had received the pathogen of the natural focus disease from a wild animal (donor) attack the person; such carriers infect the non-immune person with the natural focus disease and the person either becomes ill with the disease or acquires immunity to it. Thus the zoonosis becomes an anthropozoonosis.

Cases are known of people becoming ill with

various diseases in uninhabited places. We have in mind diseases which are endemic or which have certain endemic aspects and which are connected with stays in undeveloped territories. Thus in the semi-desert on the [illegible] of the Murgab River in Turkmenia in the Nineteenth Century almost all the personnel of several army regiments came down with cutaneous leishmaniasis (Borovskiy's disease), called "pendinka." The reasons for this occurrence remained unknown until the Twentieth Century. There were instances also of severe and apparently infectious diseases which attacked the brain of people who had penetrated into the wild taiga.

With respect to the cited examples of people being afflicted with diseases under natural conditions, certain aspects are very characteristic. They are the relation of the diseases to a specific geographic landscape (semi-desert, taiga, steppe) and their seasonal nature (spring, beginning of the summer, etc.).

In uninhabited places it is not possible to pass such diseases from one person to another; therefore the source of the disease should be sought among the animals which inhabit these places. Under the conditions of untouched nature for various geographical landscapes it is obvious that there are: 1) pathogens of certain transmitted diseases; 2) animals which can be donors of these pathogens; and 3) carriers -- bloodsucking mites and ticks or insects; the latter in turn transmit the pathogen which they have received to receptive animals -- the recipients. Together with the indifferent organisms they form the biocenosis. Man under certain conditions can be the recipient of the pathogen.

As a result of extensive expeditionary, laboratory, clinical, and literary research, Ye.N. Pavlovskiy in 1939 established the study of the natural foci of transmissible and parasitic diseases. At the present time the problem of the focus of a series of non-transmitted diseases and plant diseases is coming under study. The main bases of this work have been the Military-Medical Academy imeni S.M. Kirov, the All-Union Institute of Experimental Medicine imeni A.M. Gor'kiy, the Academy of Medical Sciences of the USSR (Department of Natural Focus Diseases of the Institute of Epidemiology and Microbiology imeni N.F. Gamaleya, etc.), the Zoological Institute of the Academy of Sciences of the USSR, and the institutions of the Ministry of Public Health of the USSR and of the Union republics.

Natural focus of diseases is characterized by the following aspects: the existence of any disease which is spread by a carrier (chiefly by mites and ticks and insects) depends on the successive transmission of the pathogen of the disease from the organism of the donor (the sick animal, virus carrier, bacteria carrier, parasite carrier, etc.) to the organism of the carrier through contact with the donor (chiefly by blood-sucking) and then on the subsequent transmission of the pathogen by the carrier to the animal recipient; the latter in turn can become the donor for a fresh group of carriers, etc. Thus there takes place the transmission or "circulation" of the pathogen of the disease from organism to organism, usually of different species, orders, or even classes,

given the presence of certain fauna and favorable conditions with respect to the external environment.

Up to the present time natural focus has been established for the following diseases: tick spirochaetosis, tick and Japanese encephalitis, ornithosis, especially dangerous infections, tick rickettsioses, toxoplasmos (a desert form of cutaneous leishmaniasis, listerellis, erysipeloid, hemorrhagic fever, nephrosonephritis, Chagas' disease in South America, etc; of the helminthoses it has been established for opisthorchiasis, diphyllobothriasis, trichinellosis, bilharziasis (schistosomiasis), etc. It is most probable that there is natural focus for pappataci fever and other diseases. Of the diseases which are found in foreign countries which have natural focus in their genesis it is possible to mention yellow fever of the jungles of the Amazon River, Kala-azar in Africa, trypanosomiasis (also in Africa), and other diseases.

The animal donors, the recipients of the pathogen of the transmissible or parasitic disease, the pathogen itself, and the carriers of the pathogen are the members of the biocenosis (preferably the geobiocenosis according to the concept of V.N. Sukachev who suggested this term) connected with known biotopes of the given geographic landscape. All relationships between the pathogen, its donors, the carriers, and the recipients developed during the process of evolution of the organisms and interspecies relations in a certain external environment without any dependence on man; it is possible for some diseases that these relationships deve-

loped even before the appearance of man on Earth.

The natural focus of a transmissible or parasitic disease is a biotope in a territory with a certain geopgraphic landscape; it is inhabited by animals whose species and interspecies relationships provide (with favorable influence from the external environment) for the consecutive, continuous circulation of the pathogen of the disease from the organism of the donors through carriers to the organism of the recipient.

The natural focus may be narrowly limited (for example, the burrow of a rodent). Such foci are called elementary foci; they may be isolated or in a given sector of the territory they may be concentrated, for example, the "little cities" of thick-tailed peschankas (Rhombomys opimus).

The natural foci may also be of another type called diffusive foci; in them the animals (donors and recipients) together with the carriers of the pathogen of the disease are distributed more widely in the territory of one or another landscape, for example, cedar-broadleaf forests; in particular its base is the zone of the natural foci of tick encephalitis in the Far East. For ticks (the carriers of the virus of this disease) the thick layer of loose litter from fallen dry leaves in such forests is especially convenient; this litter does not have such sharply outlined borders as the interior of a rodent's burrow or of a predatory mammal's den. In the area of a diffused natural focus, crawling carriers are not encountered at all points (such is the "mosaic" of distribution); for example,

Ixodes persulcatus ticks (the carriers of the virus of tick encephalitis) in the taiga accumulate on the paths along which animals go to waterholes and which may be used by man. The accumulation of Ixodes persulcatus ticks on the paths is facilitated by their fine sense of smell which helps them to occupy a position from which they can land much more quickly on a passing animal or man.

A man or receptive animal (some animals and birds are not sensitive to the virus of tick encephalitis and the virus perishes quickly; therefore under the conditions of research and experimentation it is necessary to determine their species quickly) who has been attacked by the carriers becomes ill if a certain dose of the virus enters his blood. The virus can be weakened through "circulation" between organisms of a different systematic position. Small doses or doses of certain viruses which have lost their virulence (for example, tick encephalitis) on the contrary vaccinate the person or animal; they do not become ill but rather acquire long-lasting immunity. This is the reason for the detection of blood serum of a number of healthy people of antibodies which neutralize infecting doses of the virus in a standard laboratory animal.

Some domestic animals (cattle) do not become ill when tick carriers of the virus of tick encephalitis suck their blood. It is possible to follow the intensification of the neutralizing force of the serum of their blood in relation to the duration of their stay in the territory of the natural focus of tick encephalitis (pasture in a woods; V.D. Solov'yev).

The natural focus of a disease can remain undiscovered as long as people who are not immune to the pathogen of the disease which is hidden in nature do not penetrate into the territory during the latent stage of the focus. The latent stage of a focus is determined by the stay-time in it of the hungry carriers which are infected with the pathogen and which are ready to attack any animal or man. While the carrier is sucking blood, the pathogen of the disease is introduced along with saliva into the blood of the recipient, i.e., the recipient is infected.

The infection of a person which is caused by the carrier depends, besides on the general pathogenicity for him of the pathogen of the disease and the dose, on a series of factors but in particular on the virulence of the given strain of pathogen. The virulence of a pathogen of a disease for a recipient of a certain species depends on the state of the recipient and on the total action of many factors, for example, the influence of the external environment (temperature, etc.) on the pathogen during the time it is in the organism of the carrier, the changing nature of the properties of the pathogen which depends on the preceding routes of circulation of the given strain which in different instances may pass through the organisms of various species of mammals and birds as well as reptiles, the individual condition of the carrier and the person, and the presence of various factors in the external environment which in certain combinations influence the conduct of the carrier.

Natural focus diseases refer to zoonoses (more precisely, to the anthropozoonoses) if man and animals are afflicted by them. Different species of wild animals of the same biocenosis under various equivalent conditions respond differently to pathogens of the same disease; such a continuous difference in relationships is a species characteristic of the animal-recipient.

For the natural foci of certain diseases it is characteristic that crawling carriers (Ixodidae ticks) receive the pathogen of the disease only from wild animal-donors and never receive them from an afflicted man (for example, in the case of tick encephalitis and tick rickettsioses). This is based on the fact that the tick carrier which is clinging to the body of a person will be pulled off and destroyed during the period of sucking which lasts several days. Even if the tick became sated with blood and dropped off itself from the body, it would not be able under the conditions of a human household to multiply and to accomplish a normal metamorphosis, during the course of the next phase of growth it would attack healthy people. Thus the carrier of some natural focus diseases cannot acclimate themselves to human living quarters and other support installations.

The general improvement of an area leads to a stifling of natural foci of, for example, tick encephalitis. Some species of carriers of other transmissible diseases (tick spirochaetosis), on the other hand, under suitable conditions can go into direct proximity with man, adapting themselves to the new conditions of their existence, and again attack man,

afflicting him with the disease and infecting the new carriers which attack him. Sometimes the donors of the pathogen of a disease enter a human abode or other buildings from a natural focus, as is the case of rodents (certain species of the genus Rhombomys in Central Asia) which are typical members of the wild fauna. Related foci of the disease develop from the basic natural focus through a breaking off process or through "irradiation" under new conditions. Such foci may become stable and long lasting (for example, recrudescent typhus in settlements with the carrier being the Ornithodorus papillipes tick, which is widely found in Central Asia).

Flying carriers, in entering a human abode, conduct themselves in different ways. Horse flies sometimes fly in masses into open and easily accessible living quarters; however, they always go toward the windows and never attack a person within the living quarters. Mosquitoes usually attack both sick and well people; many of them remain in the living quarters until their eggs mature.

The existence of the natural focus of a transmissible disease is determined by the biotope and the completeness of its biocenosis: donors, carriers, recipients of the pathogen of the disease, the pathogen itself, and the influence of factors in the external environment which facilitate or, in any case, do not hamper the unobstructed transmission of the pathogen from one organism to the other. The existence of natural focus diseases depends on the total interaction of these five determinant conditions.

The role of the carrier is especially important although each component of these five conditions is of definite importance. It is the ecologo-biological and physiological characteristics which establish the "epidemiological face" of the transmissible disease when it is being transmitted to people.

In the composition of a natural focus there can be the pathogen of not only one disease and animal recipients belonging to various species (so-called multiple natural focus diseases).

What are the distinguishing epidemiological characteristics of a disease with natural focus? First of all, there is the season (calendar time) of the disease which is determined by the time of arrival in the biotope of the natural focus disease of hungry infecting carriers which are at their greatest virulence and activity in attacking their source of food, especially man. This general situation can be described in detail as follows: with what part of the day and with what factors of the external environment is the activity of the carriers connected. Some of them may attack at any time during the day or night, in dry weather, and in a light rain (for example, some meadow ticks and malanders). Horseflies attack only during the daylight, especially when there is bright sunlight; the ordinary nocturnal activity of mosquitoes undergoes patterns of change (the other conditions remaining the same) during the course of the lunar month, giving two maximums (evening and morning) at the new moon, full nocturnal activity during the full moon, and some retention of the expended maximum activity as the moon

wanes (A.S. Monchadskiy). This (in conjunction with other factors) establishes the epidemiological unevenness of various parts of the lunar month and of the days with respect to mosquitoes attacking man, their flying into buildings, and consequently the transmission by them of the pathogen of a transmissible disease of man.

A second very important epidemiological aspect of natural focus of a disease is the nature of the places where man can be infected with a transmissible disease. This occurs in a geographical landscape containing natural foci of the given transmissible or non-transmissible disease. Non-flying carriers (pasture and other ticks) do not tend to active migrations; they hold more firmly to the biotopes (points) of a certain geographical landscape which are characteristic for them. Therefore, for example, the infecting of man with tick rickettsiosis transmitted by ticks of the genus Dermacentor occurs in the steppe zone of the Asiatic part of the USSR.

Flying carriers can depart from the natural focus of a transmissible disease with which they are closely connected during the course of the metamorphosis and stay of their mature form. Examples are the Phlebotomus and the holes of rodents (large peschanki, etc.) in the southern desert; all phases of the metamorphosis of the mosquito are conducted within the holes where the female lays its eggs. Here the larva emerge which feed on the dry droppings of the rodents (the larva are not parasitic). The larva make cocoons and a new generation of males and females of the Phlebotomus emerge from the cocoons. Towards night and during the

night the females fly freely and can fly to a distance of up to 1.5 kilometers from their holes. They may return to their own hole or to a different one. In the latter case, a new elementary focus of the disease naturally develops. The Phlebotomus can remain in a new settlement where man has created suitable living conditions for them.

Other flying carriers are connected with a natural focus of diseases for only the short time necessary for feeding on the blood of a donor. Thus mosquitoes (the carriers of the virus of Japanese encephalitis) settle in the sands in shallow coastal water spots by the sea; the females of these mosquitoes attack birds nesting nearby on the cliffs and from them receive the virus of mosquito encephalitis (P.A. Petrishcheva). In going away from the initial places where they were infected,they attack man in a different situation.

Of the ticks of the genus Dermacentor only the mature adult specimens attack man and large animals; therefore, only they are able to infect man and large animals with typhus fever.

Thus, the natural foci of transmissible diseases are tied to certain geographic landscapes which can be vitally changed by the economic or other activity of man (so-called anthropourgic foci of diseases), not to mention special measures to eradicate such foci. All this leads to a stifling of the natural foci of a disease to the creation of new foci, or to bringing the foci of the disease directly to man.

Nevertheless, the primary tie of the natural

foci with the geographic landscapes of the country does not lose its basic importance, even on the border of different landscapes. The "principle" lies in the matter of the place of preservation of the pathogen of the disease during the interepidemic period which sometimes lasts for years.

The determination of the actual geographic (primary) distribution of the diseases under study can be approached on the basis of determining the distribution of the natural foci of the diseases throughout the territory of the continent and generally throughout the earth's surface; even though people have not become infected from them, their potential natural foci have developed and do exist.

If medical statistics for the registration of transmissible diseases establish the number the number of sick persons who seek and obtain assistance at medical facilities in a given area, then by this data it is possible to draw maps which, however, do not always give a true picture of the geographic distribution especially for transmissible diseases with long incubation periods (malaria and rishta, one of the forms of cutaneous leishmaniasis). During the course of the incubation period, the person who has been infected may move to another area where instances of the particular disease have not been noted or could not occur.

The area of transmissible diseases having specific carriers is determined by the geographic distribution of the latter; however, cases of persons being afflicted with this disease will not be found at every

point within the zone of distribution of the specific carrier (there is a mosaic pattern). For example, the Crimean Peninsula has in its fauna the Phlebotomus papatasii which is the carrier of the pathogen of cutaneous leishmaniasis; however, this disease does not occur in Crimea despite the fact that there are many people there.

The true outline of the geographic distribution of transmissible diseases which have their own natural foci (nosogeography) is determined by the localization of the latter, including those cases when discovered foci have still not manifested themselves with respect to man.

The true determination of the presence of natural focus of diseases requires for a beginning complex zoological, parasitological, and virus research. This is necessary in studying new diseases and new territories. If cases are already known of people being ill with such a "new" disease or if cases of illness (sometimes of a group nature) are related to the temporary or constant location of the sick persons in a sector of the specified territory of the geographic landscape, then clinicians, epidemiologists, and other specialists are employed in a combined research effort. A series of "new" diseases which were discovered in the Soviet Union were indeed new for the doctors who only now are able to identify them correctly. They had existed for a long time in the territory of this huge country; however, until this time they had not been singled out by doctors as being separate nosologic entities; they were either

"gross" diagnoses or simply remained unknown to medical science.

For the rapid evaluation of the possible epidemiological danger of a territory with respect to the presumed presence in it of still hidden natural foci of diseases, partial indicators of known or studied diseases should be used. The first such indicator is the detection of carriers of the pathogen of a disease and the determination of the spontaneous infection of them by the pathogen; the general preliminary evaluation of the unsatisfactory nature of the area with respect to the possible presence of natural foci of a disease, based on the general character of the geographic landscape of the area, is of great importance. At times it is necessary very quickly to evaluate the epidemiological significance of a territory for conducting possible prophylactic measures. In such cases the nature of the geographic landscape of the area (landscape epidemiology) is first determined.

The natural foci of transmissible diseases remain hidden until non-immune people appear in their territory. Cases of tick encephalitis are noted among woodcutters and other persons working in the taiga. People become ill with tick rickettsiosis in the steppe zone, with a rural form of cutaneous leishmaniasis in the semidesert and desert zone, with tick spirochaetosis in the southern mountainous zone, etc.

Groups of non-immune people who are sent for various kinds of work to places suspected of having natural foci of diseases or who are developing territory in the virgin and fallow land areas and to

other places should first of all be protected from possible diseases by individual and collective non-specific preventive measures. These measures naturally precede possible steps to render the area harmless or to eradicate the natural foci of disease.

Some transmissible diseases at a given stage of evolution are diseases only of man (anthroponoses) or only of farm or wild animals (true zoonoses). The pathogens of these diseases are transmitted from a sick person (or parasite carrier) to a well one only through the agency of specific carriers which multiply under natural conditions and only at a certain stage of their life cycle come in contact with people or with domestic animals. Upon such contact the potential carriers receive the pathogen of the disease from the animal donors; the pathogens, given the presence of favorable environmental factors, spend part of their life cycle (usually the phase of multiplication) in the carriers; the pathogen then reaches an "exit point" in the carrier, thereby enabling the carrier to pass the infection; the exit point can often be the mouth organs of the carrier or its anal orifice.

The carriers can live in natural surroundings for an indeterminate length of time. For example, it has been established that four species of malarial mosquitoes are found in the depths of the Kara-Kum Desert (P.A. Petrishcheva). With respect to the presence in them of malarial plasmodia, they, of course, are sterile. If gametocarriers and people who have not had malaria appear in area where malaria mosquitoes are found, then with favorable external factors and in

the absence of preventive measures the sterile malaria mosquitoes can become infected by the malarial plasmodium of the gametocarriers. Given the presence of favorable temperature, time of the year, and other environmental factors, the malaria mosquitoes which drink the infected blood themselves become infective for healthy people; in the absence of prophylactic measures, an outbreak of malaria occurs and a new focus is created in an uninhabited and previously little lived in area.

The foci of haemosporidiases of domestic animals (piroplasmoses, etc.) which are spread among farm animals (horses, cattle, sheep, etc.) by ticks (Ixodidae) living in the pastures develop in a similar way.

Such transmissible diseases and also malaria are called diseases with semi-natural foci; the creation of such foci in a final direct or indirect form depends on man (the antropourgic foci of diseases).

What is the importance of natural and semi-natural focus of transmissible disease from an epidemiological point of view? It is determined by the localization of parts of the population, by the nature of the places used for settlement and for various kinds of work performed in their development, and by the degree and nature of the contact of people with the natural surroundings.

In order to evaluate the situation properly, the doctor should have a basic concept of the nosogeography of a disease with natural focus in light of the data of the area and landscape epidemiology and parasitology.

A most important practical conclusion from the

study of natural focus of diseases for the medical service is with respect to the accomplishment of prophylactic measures at inhabited points as well as complex measures designed to render harmless or eradica natural foci of transmissible diseases.

The basic measure of the first order is the individual and group protection of people from attack by the carriers of transmissible diseases. A measure of protection is provided by the use of the protective nets of Ye.N. Pavlovskiy against flying bloodsucking dipterous insects, including the carriers of malaria, cutaneous and internal leishmaniasis (Central Asia, Eastern Transcaucasia), pappataci fever (in the same area), tularemia, and Japanese (mosquito) encephalitis; dimethylphthalate and other repellents (See "Repellents") for rubbing on the face or hands should also be used extensively.

The aerosol containers of B.N. Nikolayev and F.T. Korovin should be used in treating closed places used for quarters and other facilities. The sides of tents are also treated with such aerosols (DDT, freon, and pyrethrum).

For protection from non-flying carriers (ticks) it is necessary to button the clothing tightly, to stick it in the trousers, to tie the cuffs , and to insert the trouser into high boots or to wrap the legs tightly not permitting the slightest cracks; one should wear th set of gear recommended by K.N. Chagin, which includes a protective net like a muffler around the neck, sewing cuffs of the same netting on the ends of the sleeves. Sometimes it is necessary to wear coveralls, keeping

only the face and hands open. It is recommended that two or three times a day that one examine the body and inner and outer clothing, destroying any crawling ticks (G.S. Pervomayskiy). With the population, sanitary-educational work is conducted by doctors and instruction is given on the indicated prophylactic measures.

The results of rendering an area harmless from natural foci of transmissible diseases can be relative (but still important) or complete. The system of measures vary depending on the nature of the natural foci of the transmissible diseases. Thus, in the steppe zone where there are foci of tick ricketsiosis, it is necessary to burn out the dead wood onto which the wintering females of ticks of the genus Dermacentor crawl, when preparing a future camp or working place; flamethrowers are even used for this. It is possible from the fall or summer of the previous year for them to acquire ricketts from steppe rodents and at the end of the next spring or the beginning of summer (depending on the course of their transformation) to infect people while they are on the steppe.

The territory of the camp itself should be cleared of grass. In digging ditches or performing other earth work it is possible with a vertical cut to uncover burrows of rodents. When this happens, it is possible for exposed parasites to attack people. It is possible that the pathogens of some diseases for which the etiology and epidemiology are still not completely known to be transmitted to people under just such a situation.

It is important to eliminate the burrows of

rodents in the area around the tents, destroying their inhabitants and filling in the burrows. In the zone of the hot deserts of the USSR it is important to eliminate natural foci of diseases such as the desert (rural) form of pendinka ulcer, tick spirochaetosis, and especially dangerous infections and to liquidate the places of habitation or temporary shelters of the Phlebotomus and of malarial mosquitoes.

In wooded areas and places which are overgrown with underbrush the underbrush is cleared and cut away and the pasture lands are improved. All these and other measures require rapid orientation in the area in order to establish the presence of carriers of transmissible diseases in different phases of their life cycle and in the various biotopes which are occupied by them. Consequently the doctors, zoologists, and parasitologists should have mastered the methods of obtaining parasitological intelligence of the area in order to prepare in time the required measures for the prophylactic protection of the people and for rendering the natural foci of the transmissible diseases harmless.

The employment of specific serums and vaccines for new, non-immune or for large groups of people is effective.

It should be considered that the complete eradication of the natural foci of transmissible diseases is a very difficult task which for a large territory may require much time and which depends on the nature of the foci of the disease and their pattern of distribution. The establishment of such a task should not in the slightest degree cause a

weakening of the attention devoted to non-specific prophylactic measures. There are cases when the mass specific vaccination of the population in a certain territory resulted in a lowering in the incidence of the given transmissible disease and in some cases to its complete disappearance. This is the case in the struggle against tularemia because the eradication of the foci of this disease requires the destruction of water mice and other rodents, mosquitoes, horseflies, ticks and other carriers which means that it is impossible to accomplish this task in any limited period of time.

The experience of mass one-time use of chloropicrin and the filling of about 500,000 burrows of peschanki for the purpose of eradicating the natural foci of cutaneous leishmaniasis (desert form) in the semi-desert in the area of one of the hydroelectric installations in Turkmenia gave excellent results (N. Latyshev, et al.). Within a radius of one to two kilometers, all the animals inhabiting the burrows were destroyed and the incidence of cutaneous leishmaniasis was lowered by 70 times, i.e., it practically ceased to exist; however, on the periphery of this sector the peschanki began again to settle in burrows. Therefore, in conducting measures to eliminate natural and semi-natural foci of diseases (even when complete success has been achieved) in a given territory, it is recommended that a permanently functioning service be organized which on a regular basis will clear the territory of the carriers or donors which begin to occupy it.

By no means all infectious and invasive diseases

are detected and studied in their basic manifestations. The study of these unknown diseases requires a concentration of scientific effort for expeditionary research and laboratory work. The success of the work depends on its organization. It should be based on ecologo-parasitological, faunal, and microbiological methods of research in the natural focus.

The study of natural focus of transmissible and parasitic diseases, as experience has shown, facilitates such work, directing the minds of the researchers to solve new problems of epidemiology which are of great theoretical and practical importance.

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THE ANTIEPIDEMIOLOGICAL PROTECTION OF TROOPS

/Following is a translation of an article by I. Yelkin in the Russian-language publication Bol'shaya meditsinskaya entsiklopediya (Great Medical Encylopedia), Vol. 26, State Scientific Publishing House "Soviet Encyclopedia," Moscow, 1962, pages 1195-1203./

The antiepidemiological protection of troops is the complex of special measures which prevent the outbreak and spread of infectious diseases among troops. These measures are conducted in accordance with appropriate plans and are in addition to the regularly conducted sanitary-hygienic measures in that specific area (See "Military Hygiene" and "Sanitary-Hygienic Support of Troops"). Taken together they are all directed at the preservation of the good physical condition of the personnel and at preventing outbreaks of disease among the troops, especially on a mass basis (See "Medical Service of the Armed Forces").

If the enemy employs bacteriological weapons (See "Bacteriological Weapons"), the series of measures comprising the antiepidemiological support of the troops

should include antibacteriological defense, a field which has very special characteristics. Besides this (medical) aspect, antibacteriological defense includes important elements concerning the support of combat operations of the troops.

Up to the Twentieth Century, military personnel always suffered severely from infectious diseases. Outbreaks of infectious diseases which were frequently observed during peacetime acquired the nature of epidemics during wartime, frequently having a decisive influence on the outcome of battles and of entire campaigns. Thus, for example, in the Seventeenth Century during the Thirty Years War an epidemic of the plague enveloped Germany, France, the Netherlands, Italy, and England. During this same period there were widespread epidemics of typhus and dysentery. During the Eighteenth Century the military campaigns of the Swedish King Charles XII were accompanied by devastating epidemics of the plague in Poland, South Russia, Prussia, and the East Sea region. The soldiers of Napoloon I at the beginning of the Nineteenth Century caused very widespread outbreaks of typhus. The Persian army which was besieging Bagdad (1820) was forced to lift its siege of the city because of an outbreak of cholera in the army.

Epidemics have caused enormous losses to armed forces. The number of those who were killed or who died of wounds had been considerably less than the number of personnel who died from disease (Table 1).

Table 1

Ratio of the Number of Personnel who Died of Wounds to the Number Who Died of Disease During Certain Wars of the 18th and 19th Centuries and the Beginning of the 20th Century

Armies and Wars	No. who died of wounds (as 100) to the No. who died of disease	No. killed or died of wounds	No. who died of diseases
British Army in War with France, 1793-1815	100:758	25,569	193,851
Russian Army in War with Poland, 1831	100:567	15,000	85,000
Russian Army in Crimean War, 1854-1856	100:219	40,551	88,798
French Army in Crimean War, 1854-1856	100:373	20,193	75,375
British Army in Crimean War, 1854-1856	100:382	4,602	17,580
British Army in Anglo-Boer War, 1899-1902	100:191	7,534	14,382
Russian Army in War with Japan, 1904-1905	100:41	31,458	12,983

The mortality rate from infections became less than the non-return losses from wounds only in the Twentieth Century in connection with the increased destructive force of the weapons, their greater velocity and range, and also as a result of the employment among the troops (in medical and prophylactic work) of the achievements of bacteriology which at this time was undergoing rapid development. In the Japanese Army during the Russo-Japanese War of 1904-1905 the number of personnel who were killed or who died of wounds was twice as great as the number who died from disease; in the French Army during the First World War the number was almost four times as great; and in the German and British armies it was five to six times as great.

In Russia during the Russo-Japanese War special organizations were formed for the first time, including sanitary-hygienic and disinfecting detachments, disinfecting-laundry trains, and sanitary observation points. A number of hospitals and infirmaries were set aside specially for the treatment of those ill with infectious diseases. The direction of the anti-epidemic establishments was centralized and was accomplished by the chiefs of the medical service of the armies and of the front. At this time attempts were also made for the first time not to evacuate those who were ill with infectious diseases deep into the rear of the country.

During the First World War in the Russian Army the plan of deployment envisaged sanitary-hygienic, disinfecting, and deinsecticizing railroad detachments

attached to the divisions and corps. The direction of the antiepidemic establishments was decentralized which made it most difficult to concentrate forces and means in the necessary areas. The virtual absence of special infirmaries for personnel suffering from infectious diseases made it necessary to evacuate them deep into the rear of the country, which also did not contribute to the success of the struggle against epidemic diseases either among the troops or among the civilian population.

As a result, even in the Twentieth Century, during the Russo-Japanese and First World Wars the number of personnel suffering from infectious diseases was two to three times as great as the number of wounded, although the mortality rate from infectious diseases had been lowered (Table 2).

Table 2

Ratio of Losses from Wounds and Diseases
(In relative values)

Wars	Armies	Losses	
		from wounds	from disease
Russo-Japanese War of 1904-1905	Russian	100	278
	Japanese	100	192
First World War, 1914-1918	English	100	196
	German	100	304

In the Soviet Army from the first days of its existence an effective antiepidemiological organization was created on a scientific basis. At first it was very weak, but already during the years of the Civil War it developed great strength as it participated actively gaining support from the commanders, political officers and the public. Already then the following important requirements were set as the basis of antiepidemiological activity: 1) the early detection of infected personnel; 2) the immediate detection of the source of infection and the way in which it reached the troops; 3) the immediate isolation of the infected person and his rapid hospitalization; 4) evacuation to the rear only to the infection station which is nearest to the front; and 5) the liquidation of the source of disease and the implementation of measures to prevent the spread of the disease by establishing antiepidemiological barriers along the troop, army, and front communication lines. The accomplishment of these requirements and the creation of the necessary material base greatly facilitated the success of the heroic struggle against infectious disease during the time of the military intervention which was a critical period for the young Soviet Republic (See "Military Medicine").

The subsequent development of the Soviet State, the growth of its economy and culture, the development of national public health, and in the final analysis the fundamental improvement of the sanitary conditions of the entire country created a very vital base for the antiepidemiological support of the population

and the army. However, under these conditions it was necessary to have precise and very advanced epidemiological organization since this was a matter of extreme importance in wartime, especially in the army.

During the Great Fatherland War there was a whole system of antiepidemiological institutions in the Soviet Army which were manned by appropriate specialists and which were equipped with the necessary apparatus and supplies. Typical epidemiological institutions included the sanitary-epidemiological detachment of an army, the bath-disinfection company, the field infection hospital, the sanitary-epidemiological laboratory of a front, the disinfection-instructor detachment of a front, the temporary sanitary-epidemiological detachment, and the sanitary control point.

The direction of antiepidemiological institutions was centralized and was accomplished by the chiefs of the medical service of armies and fronts which concentrated the appropriate forces and means where required. The principle of treating personnel with infectious diseases within the area of a fighting army at special mobile field infection hospitals (See "Mobile Field Infection Hospital") was strictly observed. Such personnel were evacuated directly to these hospitals from the division aid stations and even from the regimental aid stations, by-passing the division aid stations. Thus the treatment of epidemic diseases was accomplished only in the area of their origin. There were no epidemics in the Soviet Army

during the years of the Great Fatherland War.

The enormous importance which is attached in the Soviet Armed Forces to antiepidemiological support is explained by the increased potential vulnerability of the troops to infectious diseases in connection with the close and continuous contact of military personnel with each other in their large military units. During wartime the threat of infectious disease increases sharply because of the unfavorable conditions in which the troops find themselves.

A source of infection within a military unit can be a chronic carrier of the typhoid or paratyphoid bacillus or also a person afflicted with a chronic form of dysentery. Especially dangerous conditions for the spread of these diseases occur when the bacteria carrier or the person with dysentery participates in the preparation or serving of food. However, most often the infection is brought into a military unit from without when new personnel arrive or someone returns from leave or a mission. Therefore, in order to prevent infectious diseases in the military unit it is very important to establish proper medical checks for newly-assigned personnel and for persons returning from missions and leave. A most important role, even when the troops are in garrison or camp, is assigned to the systematic observation of the epidemic state of the surrounding population. When an infection is brought into a unit or when there are sporadic cases of diseases, an entire complex of measures is implemented in order to localize and eliminate the epidemic source.

The troops experience even closer contact with the civilian population during maneuvers. Infectious diseases can develop in a military unit under these conditions as a result of contact between the personnel and the local population among which are epidemic sources. In addition, maneuvers can be conducted in areas with natural foci of tularemia, encephalitis, and other transmissible diseases.

Under combat conditions the ways for infection to reach the troops and consequently the methods of fighting infection have certain differences in comparison with peacetime. In a case of an active army, infection can be brought into a military unit with the arrival of new personnel among whom there may be individuals who became infected at assembly points or while enroute to the front, by individuals returning from leave or missions who have associated with sick persons or disease carriers while away from the unit, during combat as a result of direct contact by officers and soldiers with infected local inhabitants, with the advance of the unit into the territory of the natural focus of the zoonosis (for example, the plague, tularemia, yellow fever, leptospitosis, cutaneous leishmaniasis, etc.), or as a result of contact with enemy troops if an infectious disease is prevalent among them (upon occupying enemy defensive installations, during the course of battle as a result of direct contact with enemy units, through prisoners of war, interrogees, etc.). The retreating enemy can intentionally leave contaminated areas, water sources, warehouses, and camps for

prisoners of war and civilians in temporarily occupied territory when there are epidemics therein. The experience of the Great Fatherland War indicates the probability that there will be such sources and means of spreading infection.

Diseases which occurred during the years of the Great Fatherland War were encountered most frequently as a result of an infection being brought into a unit rather from originating within the unit. Therefore, measures conducted by the military medical service together with civilian organs of the public health services in localizing and eliminating epidemic foci among the population in the territory where the troops are quartered or where fighting is taking place are of decisive importance.

In cases when infection nevertheless does enter a military unit, it becomes very dangerous to the unit. The living and working conditions in a military unit facilitate the spread of infection in all instances where the necessary prophylactic and antiepidemic measures are not conducted in time. In peacetime this is based on the characteristic garrison dislocation of the personnel with the close daily contact which occurs in the sleeping quarters, mess halls, classrooms, etc. The situation in camps is only slightly different; the sanitary conditions in camps may be less favorable than in the winter garrisons.

In a combat situation there is a fundamental change in the conditions with much greater complexity from an epidemic point of view. The troops must be

quartered in chance facilities or directly in various field installations. Water supply and feeding for the troops are frequently difficult. Frequent moves of units to areas about which little is known and which sometimes are dangerous from an epidemic point of view give rise to the possibility of the sudden appearance of infectious diseases. The stages of medical evacuation can be considerably removed from each other. It is possible that communications may be interrupted and that obstacles to evacuation may develop.

Under these conditions the importance of a previously developed series of measures to prevent the outbreak and spread of infectious diseases among the troops becomes even greater. These measures include: 1) continuously conducted measures with respect to the sanitary-hygienic control over the quality of the food, the conditions of the mess facilities, and the health of the personnel preparing the food as well as over the quality of the drinking water and the sanitary care of the buildings and surrounding territory; 2) hygienic education of the personnel, teaching them measures for personal protection against infectious diseases; 3) anti-parasitic measures; 4) preventative shots (against typhoid fever, A and B paratyphoid fever, and tetanus for all personnel in the Soviet Army and also where indicated against the plague, cholera, and certain other infectious diseases); chemoprophylaxis is also employed against malaria if the military unit enters territory which is unfavorable with respect to

this disease; 5) measures to prevent the entry of infection into the military unit (the creation of so-called barriers on the routes where the disease may be spread); and 6) the timely detection, isolation, and hospitalization of persons who are ill and the implementation of measures to localize and eliminate the epidemic focus.

The proper organization and conduct of sanitary-epidemiological intelligence (See "Sanitary-Epidemiological Intelligence") and the timely implementation of measures to localize and eliminate epidemic foci among the civilian population are of great importance to the successful antiepidemiological support of the fighting forces.

The command and administrative and supply organs which supply the personnel with the appropriate sanitary and living conditions while organizing the supply of good quality food and water and which check on the proper adherence to sanitary rules in the units and the implementation of all prophylactic measures dicated by the given epidemic situation participate in the antiepidemiological support of the troops.

The medical service of a regiment, along with general sanitary measures and the accomplishment of shots, is responsible for the timely detection of epidemic foci among the civilian population and for conducting measures to prevent contact with them on the part of the personnel of the military units. It is important to detect persons ill with infectious diseases as early as possible, to isolate them, and to evacuate them to a hospital. In doing this the

medical personnel of the regiment use clinical and epidemiological methods of diagnosis.

An isolation ward (See "Isolation Ward") is established at the regimental aid station or the aid station of a similar unit with three to four cots for the reception of personnel who are ill with infectious diseases or who are suspected of having such diseases. Not later than the next day the sick person is sent to the isolation ward of the division aid station.

Its functions include the organization and conduct of all measures of prophylaxis against infectious diseases in the regiments of the division and in the area of its deployment, the sanitary treatment of casualties and sick personnel arriving at the division aid station, and the necessary disinfecting measures. It is also provided with equipment for laboratory-diagnostic work.

In order to prevent newly assigned personnel from bringing infection into a military unit, it is necessary to perform special measures throughout the route of movement of such personnel from the moment of their arrival in the reserve regiments of the rear until they arrive at their assigned place. With this purpose in mind sanitary control points are established on the railroads and the highways; their purpose is to detect and isolate personnel with infectious diseases and where necessary to quarantine the units and march commands which are moving and, when indicated, to perform their sanitary processing. When new personnel arrive at the reserve regiment of a front, they should be placed in quarantine facilities and be given

sanitary processing and a careful medical examination. When a person suffering from an infectious disease is detected, he is isolated and all those who arrived with him are detained in the quarantine facility for a period equal to the maximum duration of the incubation period for the given disease (from the time that the last sick person was isolated). If the combat situation requires that the time spent in quarantine be shortened, observation of the newly assigned personnel should be continued in the subordinate units.

Prophylactic measures along the routes of medical evacuation are also of vital importance. Care is necessary in order to detect each infected person as early as possible and subsequently to conduct the full complex of antiepidemiological measures as dictated by the nature of the infection. In addition, sanitary treatment of the personnel being evacuated is conducted at all stages of the medical evacuation, beginning with the division aid station.

The system of evacuating infected personnel is of greatest importance. The personnel with infectious diseases should be evacuated directly to a hospital from the isolation wards of regimental and division aid stations. For this reason the hospitals should be located as close as possible to the division aid stations. Such ill personnel are ordinarily evacuated on the transportation of the hospital. It is also possible to use general purpose sanitary transportation. The vehicles should be disinfected at the hospital.

The hospital is the final stage of evacuation for personnel with infectious diseases. Their trans-

portation to other medical facilities (for subsequent stages of medical evacuation) can only be forced (based on the combat situation) and in such cases should be conducted with the strictest observance of the appropriate antiepidemiological rules (using special vehicles with accompanying medical personnel, with supplies of disinfectants, along a planned route, and to a specially prepared medical facility).

The antiepidemiological support of troops is accomplished according to a plan which includes: the characteristics of the epidemic situation both among the troops and in the territory where they are operating; the characteristics of the forces and means which are available to the military medical service and to the local public health organs; the distribution of forces including reinforcements for the more important sectors; and the plan of maneuver for reserves and the sequence and times for reports.

If the enemy employs bacteriological weapons, a series of additional problems arises in connection with the changes in the methods of infecting personnel (aerosol infection acquires almost universal importance), with the increase in the number of objects requiring bacteriological investigation (the air, the surface of objects, clothing, etc.), etc. In connection with this, the timely indication of the employment of bacteriological means (See "Indication of Means of Producing Casualties") acquires exceptional importance. Specific preventative measures directed at creating long lasting immunity against the most threatening infections and extra chemoprophylaxis (antibiotics, etc.) are of

special significance.

Under conditions where there is a threat of bacteriological attack, the basic antiepidemiological measures become especially important. This includes, in particular, continuous sanitary-epidemiological intelligence, effective antiepidemiological barriers, the early detection of personnel with infectious diseases, their timely isolation and hospitalization, etc. In the case of an attack with bacteriological weapons, there is a real possibility that the front line troops will transmit the infection to the rear. In connection with this, preventative measures during stages of evacuation become more important.

See also "Immunization of Troops," "Medical Intelligence," and "Sanitary-Hygienic Support of Troops."

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THE GAS MASK

/Following is a translation of an article by A. Mokeyev in the Russian-language publication Bol'shaya meditsinskaya entsiklopediya (Great Medical Encyclopedia), Vol 26, State Scientific Publishing House "Soviet Encyclopedia," Moscow, 1962, pages 1112-1122./

The gas mask is a device for protecting the respiratory organs and eyes of man and animals from action of toxic chemical agents (See "Toxic Chemical Agents"), radioactive dust, bacterial aerosols, and also harmful compounds which are contained in the air under production conditions.

According to their principle of operation, gas masks may be of the filtering or sealed types. In filter gas masks the air is decontaminated by filtering it through substances which absorb the harmful admixtures. Sealed gas masks completely insulate the respiratory organs from the surrounding atmosphere and provide for the absorption of the carbon dioxide in the exhaled air and for the supplying of oxygen for respiration.

Filter gas masks (filter masks) are subdivided into damp and dry types. Damp gas masks served as the first means of protection against toxic chemical agents. They were masks of various shapes which before

being used were impregnated by solutions which absorb toxic chemical agents. The most advanced damp gas mask was the mask of N.P. Prokof'yev (Figure 1) which was made of 30 layers of gauze which were impregnated with a mixture of hyposulfite (14%), urotropin (18%), glycerin (14%), potash (7%), and water (47%). With the development of the means and methods of chemical attack the damp gas mask ceased to be a dependable means of protecting the troops. The turning point which established the direction of all subsequent development of gas mask equipment was a discovery made by N.D. Zelinskiy (See "Zelinskiy") who in August 1915 proposed the use of activated charcoal (See "Activated Charcoal") as protection against toxic chemical agents. The charcoal gas mask which was created by Zelinskiy on this basis was the first dry gas mask (Figure 2). It consisted of a metal canister with activated charcoal and a rubber helmet designed by Kummant which differed from the damp gas mask in the universality of its protective action and in its great protective power.

Fig. 1. N. P. Prokof'yev's mask.

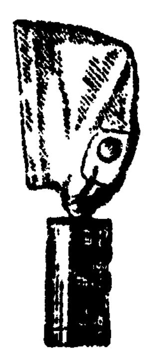

Fig. 2. N. D. Zelinskiy's dry gas mask.

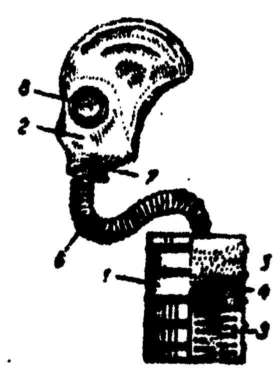

Fig. 3. Diagram of a modern filter gas mask.

The modern filter gas mask (Figure 3) consists of a respirator box (1) and a face part (2). The face part in the form of a mask or helmet-mask is connected to the box directly or by a corrugated hose (6). The box (canister) contains an anti-smoke filter (3) and a gas absorber consisting of a chemical absorbent (4) and activated charcoal (5). Eyepieces (8) are mounted in the face part; they have a device for preventing fogging of the glass. There is also a valve-distributer system (7). The valve-distributer system consists of an intake (1) and an exhaust (3) valve and deflectors (2) (Figure 4).

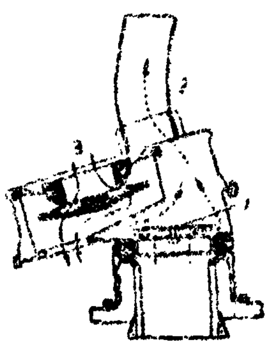

Fig. 4. Valve distributor system of the mask.

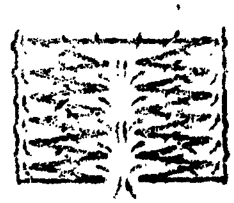

Fig. 5. Diagram of an antismoke filter in the form of a harmonica (arrows indicate the direction of the air flow).

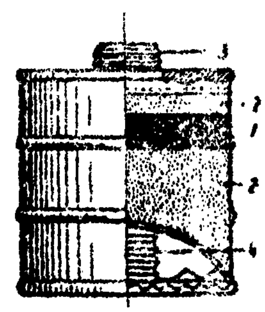

Fig. 6. Hopcalite cartridge:
1 - hopcalite
2 - dessicant layer
3 - threaded joint
4 - internal threaded joint.

The antismoke filter (Figure 5) is made of fibrous materials and has the form of a harmonica; it cleans the air of aerosols and dust particles which settle on the fibers of the filter.

The absorption of toxic chemical agents and other harmful vapors from the air is accomplished by the gas absorber of the canister. At the basis of this are the complex physical-chemical processes of adsorption, hemosorption, and catalysis. Of greatest importance in this is the process of adsorption of vapors and gases by activated charcoal. The adsorption of acid toxic chemical agents and the products of their hydrolysis -- acids, which undergo sorption by charcoal poorly, is accomplished by chemically uniting them with bases which are part of the chemical absorber.

In modern gas masks a universal absorber is frequently used in place of a chemical absorber; it is activated charcoal to which has been added an absorbent mixture and certain additives which strengthen the catalytic capability of the sorbent.

The gas absorber of modern gas masks does not absorb carbon monoxide. A hopcalite cartridge (Figure 6) is used for protection against carbon monoxide. In dry air and in the presence of hopcalite, carbon monoxide is oxidized by the oxygen of the air to carbon dioxide. Hopcalite is sensitive to moisture, and therefore the protective capability of the cartridge is determined by the time of action of the drier.

The gas mask is an important means of protection against the casualty producing effect of various types of weapons, preventing the penetration of poisonous and radioactive substances and also of particles of aerosols with bacterial means into an organism through the respiratory tracts.

Because of this there are various requirements made of the gas mask, the most important of which are: polyvalence of protection from various substances regardless of their state (vapor, gas fog, smoke, dust), great protective strength, and dependability and convenience of use.

From a medical point of view it is important that the gas mask have no significant effect on the physiological functions of the organism and not prevent people from performing varied activities.

The effect of the gas mask on the organism of man is many-sided. The main factors establishing the negative effect of the gas mask on the organism are resistance to respiration, the presence of a harmful space in the gas mask, and the unfavorable effect of the face part on the organs of sense when the gas mask is being used.

The resistance of the gas mask to respiration is caused by the friction of the air as it passes through the gas mask. The magnitude of this friction in modern

gas masks is relatively small. The resistance to respiration causes a change in the pressure in the chest cavity and affects the functioning of the heart because it leads to an increase in the flow of blood into the right side of the heart when inhaling and to a decrease when exhaling. During this an increase can be observed in the momentary volume of the heart without there being any significant change in the pulse frequency. The increase in the momentary volume of the heart and the overcoming of the negative pressure in the chest cavity cause an additional load on the heart muscle. The resistance of the gas mask to respiration is overcome by the working of the respiratory muscles which causes an additional load on the respiratory musculature. The extent of this load increases with the growth of the resistance and can attain a considerable magnitude. At the same time the resistance to breathing causes a change in the duration of the phases of the respiratory cycle; the phase during which the resistance occurs becomes longer. During this the volume of the ventilation is lowered by approximately 5 to 10% in comparison to a period of respiration without a gas mask.

The harmful space in modern gas masks is limited to the space under the face part and the valve box. The volume of this space is about 200 to 300 cubic centimeters. Its physiological importance involves the change in the gas composition of the inhaled air. Upon exhaling, the carbon dioxide content in the air under the mask reaches 3 to 4%. Upon inhaling, the air from the space under the mask enters the lungs along

with the atmospheric air which leads to an increase in the CO_2 content and to a decrease in the O_2 content in the inhaled air. For deep breaths the negative influence of the harmful space is less, but with short shallow breaths its significance grows sharply.

The face part of the gas mask disrupts the normal conditions of sight, hearing, speech, smell, and receptivity of the skin of the face. Visual acuity does not suffer appreciably under normal lighting conditions and normal transparency of the eyepieces. But it drops sharply with poorer illumination, especially at night or when there is condensation on the eyepieces. Spatial orientation, especially at night, becomes difficult, which is a consequence of the restriction of vision and the stopping of the receptivity of the skin of the face. Hearing is noticeably lowered when using helmet-masks, but is not affected when using ordinary masks. Speech is difficult, especially with respect to distinctness and clarity of speech. The pressure of the face part on the skin of the face and head is also of great importance in practice. The painful sensations and rubbings which occur during prolonged use of the gas mask limit the time people can spend wearing the gas mask. This negative factor is partially (but not completely) eliminated by carefully exhausting the mask.

As a whole the influence of the gas mask on an organism in the state of rest is little noticeable, but is clearly manifested during work processes, especially ones involving great physical loads, and causes a lowering of ones ability to work. In this

an especially important aspect is the action on the central nervous system causing a slowing and weakening of the analytic-synthetic activity of the central nervous system and a worsening of the coordination of the motor reactions. The negative influence of the gas mask on the organism can be overcome in part by gas mask training, which should have physical culture and sports as a base.

Medical counterindications to using the gas mask are varied and in each concrete instance are determined by the state of health of the sick person. Among the diseases which prevent the use of the gas mask are the following in particular: organic ailments of the cardiovascular system with decomposition manifestations; sclerosis of the coronary vessels with stenocardiac manifestations; expressed forms of hypertony; severe ailments of the respiratory organs (pneumonia, exudative pleurisy; tuberculosis, abcesses, and bronchoectasis); severe ailments of the nervous system (meningitis, acute disruption of the blood circulation of the brain, tumors and concussions of the brain, and diffused sclerosis); wounds and damage to the skull accompanied by increased intracranial pressure; penetration wounds of the chest and of the stomach cavity; ruptures of internal organs and internal bleeding; various forms of shock; sharply expressed respiratory disorders, circulatory disorders caused by poisoning (toxic chemical agents); etc.

Sealed gas masks are intended for use when there are high concentrations of harmful substances or a lack of oxygen in air. They are employed in the

mining and chemical industries, in firefighting and underwater work, and also in underwater sports and in climbing high mountains. They include, in particular, the KIP-5 (Figure 7) and the RKK-2 (Figure 8). In devices of this type the exhaled air is rid of carbon dioxide in the regenerative cartridge, the gas absorber of which includes an alkali; and in the respiratory bag it is mixed with oxygen from the oxygen cylinder. Upon inhaling,air enters the lungs from the respiratory bag.

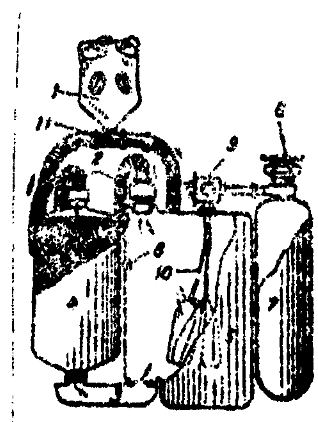

Figure 7. Diagram of a KIP-5 sealed oxygen gas mask: 1 -- mask; 2 -- corrugated hose; 3 -- lower connecting box; 4 -- regenerative cartridge; 5 -- respiratory bag; 6 -- excess pressure valve; 7 -- cylinder with oxygen; 8 -- valve; 9 -- combined mechanism for supplying oxygen; 10 -- automatic lung; 11 -- valve box.

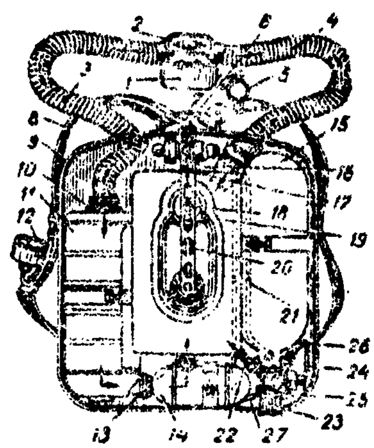

Figure 8. RKK-2 regenerative sealed gas mask:

1 - saliva collector;
2 - lip piece;
3 - exhaust hose;
4 - intake hose;
5 - nose clamp;
6 - high pressure tube to the manometer;
7 - reduction valve for supplying oxygen;
8 - shoulder strap;
9 - lower cover of the gas mask
10 - exhaust valve;
11 - regenerative catridge;
12 - manometer;
13 - connection to the respiratory bag;
14 - moisture absorber;
15 - oxygen cylinder;
16 - intake valve;
17 - connection from the reducer to the respiratory bag;
18 - excess valve;
19 - respiratory bag;
20 - feather (lever) of the automatic lung;
21 - oxygen line to the reducer;
22 - emergency valve connection;
23 - shut-off valve;
24 - distributor T-joint;
25 - emergency valve button;
26 - oxygen line to the emergency valve;
27 - oxygen line to the manometer.

The physiological-hygienic characteristics of sealed gas masks are based in general on the increased carbon dioxide content of the inhaled air, the resistance of the device to respiration, and the high temperature and moisture content of the inhaled air. The increased carbon dioxide content in the inhaled air in the KIP-5 is based on the harmful space of the mask and the incomplete absorption of the carbon dioxide by the regenerative cartridge. A properly operating regenerative cartridge for the first 1½ hours practically

will not pass carbon dioxide; then there is a jump and toward the end of the second hour the carbon dioxide content can reach 1-1.5%. The danger of acute carbon dioxide poisoning is possible only when the regenerative cartridge and valve box are defective when the exhaled air enters the respiratory bag. Oxygen starvation is possible when there is insufficient oxygen in the oxygen cylinder, in the case of a defective oxygen supply mechanism, and also when there is a high concentration of nitrogen (more than 1%).

The temperature of the inhaled air in the KIP-5 can reach 38-40 degrees Centigrade, which for a realative humidity of 100% can cause a number of unpleasant sensations resulting from the condensation of moisture on the skin of the face and the mucous membranes of the upper respiratory tracts and from the evaporation of the skin integument.

Based on their purpose, gas masks are divided into general troop (or troop), civilian, children's industrial, and special types.

There are no basic differences in the construction of the different purpose gas masks. Civilian gas masks (Figures 9 and 10) are intended for the protection of the broad masses of the civilian population during wartime. They protect the respiratory organs and the eyes against all known casualty producing substances (toxic chemical agents, radioactive substances, and bacteriological means).

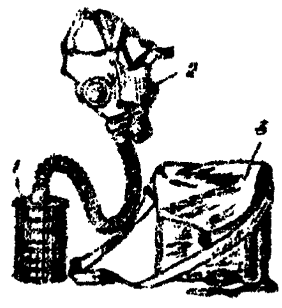

Fig. 9

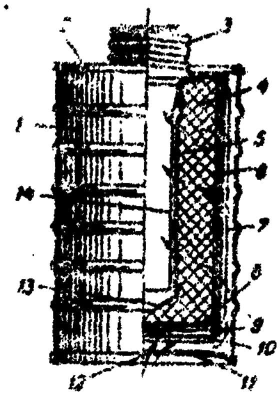

Fig. 10

Fig. 11

Figure 9. GP-4U civilian gas mask: 1 -- antigas canister; 2 -- face part; 3 -- gas mask carrier.

Figure 10. Diagram of the construction of the antigas canister of the GP-4U: 1 -- body; 2 -- cover; 3 -- screw neck; 4 -- gas absorber; 5 -- small perforated cylinder; 6 -- large perforated cylinder; 7 -- antismoke filter; 8 -- movable bottom; 9 -- spring; 10 -- immovable bottom of the large perforated cylinder; 11 -- bottom of the canister ; 12 -- air opening; 13 -- cup; 14 -- antidust tampon.

Figure 11. Child's protective chamber.

Various chambers of the envelope type have been proposed for antigas protection of infants. In them the decontamination of the air is accomplished with an ordinary antigas canister while the supplying of air is performed through the use of bellows or by means of the breathing of the mother (Figure 11). For older

children (up to 14) small-size children's gas masks are made which are similar in their construction to the civilian gas masks.

Special gas masks differ ordinarily in the construction of the face part and are intended for the protection of people who cannot use ordinary gas masks because of the state of their health or as a consequence of the specific nature of their work. For example, in the case of wounds of the head and face the use of ordinary gas masks is impossible. For the protection of such persons there are special face parts which, as a rule, are like a kind of bag in which the elements of the face part of the gas mask are installed (Figure 12).

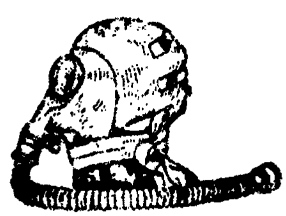

Fig. 12. Gas helmet for personnel with head wounds.

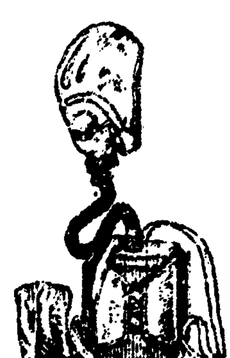

Fig. 13. Industrial filter gas mask type BGAMV-1.

Fig. 14. PSh-1 hose gas mask of the self-inhaling type

Fig. 15. DPA-5 hose gas mask with air supply provided by an air blower.

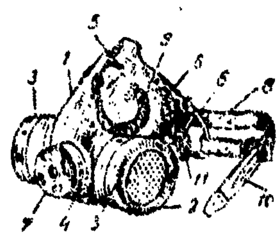

Fig. 16. Small dry horse gas mask: 1 - mask; 2 - protective canister; 3 - end piece of the canister; 4 - end piece of the exhaust valve; 5 - center half-ring; 6 - side half-ring; 7 - exhaust valve; 8 - rubber plait; 9 - frontal strap; 10 - rear strap; 11 - swivel of the bit of the gas mask.

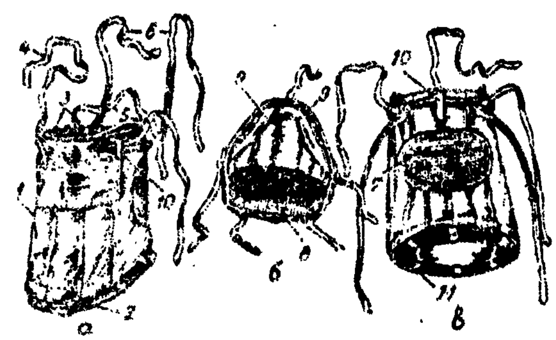

Fig. 17. Damp horse gas mask: a - general appearance; b - top view; c - rear view; 1 - conical bag; 2 - girdle; 3 - stiffeners; 4 - frontal strap; 5 - circular straps; 6 - rear straps; 7 - mouthpiece; 8 - palatal pad; 9 - lateral pads; 10 - keepers; 11 - girdle loops.

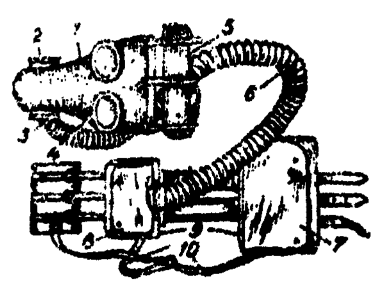

Fig. 18. Gas mask for dogs: 1 - mask; 2 - exhaust valve; 3 - intake valve connecting piece; 4 - eyepieces; 5 - collar; 6 - corrugated hose; 7 - case for the mask and corrugated hose; 8 - case for the protective canister; 9 - pack support; 10 - body strap.

The line of obturation in such helmuts usually passes along the neckline.

Industrial gas masks are divided into filter, sealed, and hose types.

The filter gas masks (Figure 13) in their construction do not differ from the troop gas masks. Depending on the nature of the decontamination of the air under industrial conditions, the gas absorber of the canisters contains mostly activated charcoal or chemical absorbents. Respirators (See "Respirators") made of fibrous materials are used for protection against dust. A special filter gas mask (the so-called self-preserver) is used for protecting workers in hard coal mines from carbon monoxide and smoke which are formed during explosions or fires in the mines.

The hose gas masks (Figures 14 and 15) are devices of the sealed type. They consist of a mask and a long rubber sleeve which makes it possible to obtain air from a separate zone. In this the air is drawn in by the strength of the respiratory muscles or is fed by a fan.

Of the domestic animals only horses and dogs are provided with antigas protection. Horse gas masks are of the damp and dry types. They, as a rule, do not have an antismoke filter because horses are largely not sensitive to the action of irritant toxic chemical agents. One of the models of a dry horse gas mask is the KSPM which is shown in Figure 16. It consists of two small canisters which are equipped with a universal absorbent (or a charcoal-catalytic agent), a mask, and eyepieces. The damp horse gas mask (Figure 17) has

the shape of a canvas feed bag made of 40 layers of gauze: it is covered with sacking. The gas mask is impregnated with a special compound which provides for the absorption of toxic chemical agents. For protecting dogs there is a special dry gas mask, the construction of which is shown in Figure 18. (See also "Antiatomic Defense," and "Sanitary-chemical Protection.")

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